

## Science Modules

**This module focuses on the Genesis cleanroom.** If you are using Genesis science modules for the first time, read the [User's Guide](#) thoroughly before you begin. ([View User's Guide as PDF.](#))

The following classroom materials are available in Portable Document Format (PDF) for your browsing and printing convenience. The files are print-optimized, and should be printed to achieve maximum resolution. **Adobe's new Acrobat Reader 4.0 is required** to view and/or print. To install the FREE reader, visit the [Adobe Web site](#).

Take a look at additional [science modules](#) that are available on the Genesis Web site. All technical terms in the science modules are compiled in the [Glossary](#) for easy access. Watch for the innovative Genesis [Cleanroom Interactive Field Trip](#) online to enhance this module.



### Dynamic Design: The Cleanroom

In *Dynamic Design: The Cleanroom*, students will become familiar with the requirements and conditions of working in a cleanroom environment. In this middle school module (grades 5-9), students will learn about the design specifications of the cleanroom and the requirements for working in NASA's cleanest room. Students will model the assembly of the solar wind collector wafers onto the array frame for the Genesis mission. In the assessment activity, students will use what they have learned to demonstrate the planning and assembly of an array frame in a simulated cleanroom environment. The cleanroom module will utilize both the video, *Cleanroom Technology, NASA Genesis Mission* and the Cleanroom Interactive Field Trip as integral parts of this education module. Upon completion of the assembly project, students will understand why working together to complete a project is essential.

#### Module Planning Guide

##### Levels of Clean

- [Teacher Guide](#)
- [Student Activity](#)

##### How Clean is Clean?

- [Student Text](#)

##### Cleanroom Technology

- [Teacher Guide](#)
- [Student Activity](#)

### Briefing

The Genesis laboratory cleanroom was used for the assembly of the Genesis mission scientific payload hardware, including assembly of the solar wind collector arrays, and will be used for handling the solar wind samples after they have been returned to the Earth. A very clean room is needed during assembly and sample handling in order to minimize contamination of the sample. Because the scientists are looking at very small elemental abundances of the solar wind isotopes, even small amounts of contamination, like dust from the air, could make it difficult to see the solar wind samples. NASA has built a class 10 cleanroom so that neither contamination nor debris will mask the solar wind samples and throw off the results. In the accompanying video, *Cleanroom Technology: NASA Genesis Mission*, students will learn about the conditions that are necessary for the assembly of the spacecraft scientific payload.

The "Levels of Clean" activity gives students a hands-on way of learning how contamination can move from one room to another. In "How Clean is Clean?" students will read an analogy from everyday life to help them understand the importance of keeping doors closed.

**Suiting Up**

- [Teacher Guide](#)
- [Student Activity](#)
- [Student Text](#)

**Washing Dishes**

- [Teacher Guide](#)
- [Student Activity](#)

**The Cleaning Room**

- [Student Text](#)

**Terrific Tension**

- [Student Text](#)

**How Clear is the Water?**

- [Teacher Guide](#)
- [Student Activity](#)

**From Macroscopic to Microscopic**

- [Student Text](#)

**Testing the Waters**

- [Student Data/Reporting Sheet](#)

**Mapping it Out**

- [Teacher Guide](#)
- [Student Activity](#)
- [Student Data Sheet](#)
- [Student Reporting Sheet](#)

**Exploration**

In the activities of this module, the teacher's primary role is Socratic. Through effective questioning, students should become aware of the unique environment of the cleanroom.

In the Student Activity, "Suiting Up," students will learn about the importance of contamination control. The focus of the activity is the parallel between suiting up for the Genesis cleanroom and dressing to do a specific job or activity.

The Student Activity, "Washing Dishes," takes students through a series of steps in which they will test and observe how soap breaks up contamination in both a guided and open inquiry.

The Student Activity, "How Clear is the Water?" illustrates how a Secchi disk that a student can make is similar to the liquid particle counter that is used in the cleanroom. Students model the process of verifying clean on a macroscopic level and read about how a liquid particle counter works on a microscopic level in "From Macroscopic to Microscopic." A simulation of the liquid particle counter can be found on the [Cleanroom Interactive Field Trip](#).

In the Student Activity, "Mapping it Out," students map out the actual placement of the wafers on the array by making a color key, then finding and coloring the locations on five arrays. Once the arrays have been mapped, students will discover why the wafers have varying thicknesses.

**Curriculum Connections****National Standards Addressed****Grades 5-8*****Science as Inquiry***

- Understandings about scientific inquiry
- Abilities necessary to do scientific inquiry

***Physical Science***

- Properties and changes of properties in matter
- Motions and Forces
- Interactions of Matter and Energy

***Earth and Space Science***

- Structure of the Earth System

***Science and Technology***

- Understandings about Science and Technology
- Abilities of Technological Design

***History and Nature of Science***

- Science as a Human Endeavor
- History of Science

***Science in Personal and Social Perspectives***

- Science, Technology and Society
- Risk and Benefits

**Additionally in Grades 9-12*****Physical Science***

- Structure and Properties of Matter

***History and Nature of Science***

- Historical Perspectives

***Science in Personal and Social Perspectives***

- Personal and Community Health

**Student Mission**

Students will work in teams to simulate the planning of assembly of wafers to gain an appreciation for the role teamwork plays in some circumstances. In order for the scientists to prepare the arrays for the spacecraft, three scientists must work as one to complete the task. Students will develop an awareness of the complexity that is involved with both working as a team and in a restrictive environment.

**Keep it Clean**

- [Teacher Guide](#)
- [Student Activity](#)

**Maintaining Clean**

- [Student Text](#)

**Planning a Party**

- [Teacher Guide](#)
- [Student Activity](#)

**Planning the Assembly**

- [Student Handout](#)

**Development**

Use the Student Activity, “Keep it Clean” to create interest in learning more about how the air quality in the cleanroom is monitored. Through a simulation, students learn about sampling and test various places in a simulated cleanroom. “Maintaining Clean” is a text that explains sampling methods and the air particle counter used in the cleanroom. Planning is the first step taken whether planning a party or building a spacecraft. Students learn the importance of planning by comparing what the scientists did when planning the assembly of the science canister to their task.

**Working Together**

- [Teacher Guide](#)
- [Student Activity](#)

**A Scientific Symphony and Tool Time**

- [Student Text](#)

**Interaction/Synthesis**

Student interactions with peers are emphasized as the class pursues the tasks set forth in the activity, “Working Together.” This activity contains work to be done in groups, with the whole class participating in reading and questions found in “A Scientific Symphony and Tool Time.”

**Putting It All Together**

- [Teacher Guide](#)
- [Student Activity](#)

**Assessment**

In the assessment activity, “Putting It All Together,” students are asked to put together what they have learned in this module to finish the work started in “Working Together.” This time however, they will be responsible for planning the work, wearing gloves, washing the tools ahead of time, and following the map they colored in “Mapping it Out” to complete the project.

**Curriculum Connections**  
**[National Standards Addressed](#)*****Assessment Standard B***

- Achievement and Opportunity to Learn Science must be Assessed

***Assessment Standard C***

- Assessment Tasks Are Authentic

This education module, *Dynamic Design: The Cleanroom* was developed by educators at [Mid-continent Research for Education and Learning](#).



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